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ABSTRACT

The paper examines the way preschool children with handicaps interact with and make their response to computer programs, suggesting that the most important factor ensuring successful computer use is finding the most appropriate method of computer access. Difficulties with software programs are noted, including problems with scanning. It is suggested that some children do not possess the required ability to make one-to-one correspondence. In addition, the variety of software programs call for generalization, a skill lacking in many young handicapped children. Difficulties in hardware configurations are also reviewed. Possible adaptations, such as keyboard overlays and expanded keyboards, are considered. Adaptations to paddles and joysticks are described. The potential use of touch screens as response modes is emphasized, as in the need for determining a child's ability to access the computer system. (CL)

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PERSONAL PERSPECTIVES ON THE IMPORTANCE OF THE RESPONSE

by Michael Rettig, Ph.D.

INTRODUCTION

In the last few years there has been a steady increase in the availability, power, and portability of microcomputers in special education. At the same time the cost of these systems has been decreasing and a wider array of adaptive computer hardware has become available. The use of microcomputers in special education has also become more varied as computers are made available to the handicapped and teachers become more comfortable with these machines.

Since 1976 a variety of articles have appeared in the literature discussing the use of computers as instructional tools for young children (Banet, 1979; Hatch, 1981; Piestrup, 1978; Smithy-Willis, Riley, & Smith, 1982; Swigger & Campbell, 1981). Many of these articles describe how microcomputers can be used to supplement instruction in such areas as pre-reading. More importantly, these articles indicate that young children are capable of using computers and enjoy their computer experiences.

Although less information is available on the use of microcomputers with preschool-aged handicapped children, several authors have described how computers can be used with this population. Work reported by Brinker & Lewis (1982), Behrmann and Lahm (1983), and Meyers (1984) indicates that computers can be used effectively by even very young handicapped children. In addition, computer projects such as those at the University of Washington, UCLA, and Activating Children through Technology (ACTT) at Western

EC 182391

Illinois University, have demonstrated that preschool-aged handicapped children are capable of using and benefiting from microcomputers.

Like many other computer projects, one of the principal objectives of HCCCP has been to use microcomputers to assist in the instruction of handicapped children and to evaluate these applications. In the last four years over 300 preschool-aged handicapped children have used Apple II computers in our schools. One advantage of our resource-sharing project is that we've been able to use computers with children in a wide array of disability areas. Because of our access to children with different disabilities, we've been able to look at how these children use and access computers.

In examining the use and applications of microcomputers in our schools, one particular problem has become apparent with children in each school. This problem involves how these children interact with and make their response to computer programs. The issue of computer access is closely tied to both hardware and software considerations. Although these two areas are discussed separately here, the interrelationship between hardware and software is an important determiner of computer access. In my opinion, FINDING THE MOST APPROPRIATE METHOD OF COMPUTER ACCESS IS PERHAPS THE MOST IMPORTANT FACTOR IN ENSURING THAT COMPUTERS CAN BE USED BY YOUNG HANDICAPPED CHILDREN.

SOFTWARE

There has been a rapid increase in the availability of software programs for young children in the last few years. When our project began in 1982, we found no more than a handful of programs available

for young children. Although the availability of software has increased rapidly, the quality of these programs, and the range of skills taught have not always kept pace. A majority of the software developed for young children focuses on pre-academic skill development. Reading readiness activities such as letter recognition and matching, and same and different discrimination are common.

The number of programs which can be used by young handicapped children has also increased. Many of these programs allow teachers to individualize activities for different children and take advantage of speech synthesizers and hi-resolution graphics. Some of the commercially available programs widely used in our preschools are Early Learning I, Preschool IQ Builder, Micro Mother Goose, and the Stickybear programs.

My experiences in using and evaluating these and other software programs with the visually impaired, physically disabled, and mentally retarded young children in our project have led to an interesting finding. With several of these programs the skills required to respond to the computer program are above those being addressed by the software's instructional goals. This problem seems most obvious in many of the programs which use a scanning mode. (For the purpose of this discussion, scanning is defined as the process of visually tracking an arrow or cursor across various items on the screen, and pressing a key or switch when an arrow, box, or cursor points to the correct answer on the screen).

A common feature in software such as First Words, Motor Training Games' A*B*C*Dragon, and Hartleys' Patterns and Sequences, is that children are required to scan items on the screen and press a switch

when an arrow, box, or symbol points to or surrounds the correct item to be matched. Although most children are able to identify the picture or match the letters or patterns, many children have difficulty using these programs because they do not understand how to respond.

In First Words (Laureate Learning Systems), for example, children see one or two pictures of common objects on the screen. They are required to select a picture as directed by the speech synthesizer. To make their response, children must press the space bar or paddle button when an orange box, moving back and forth at predetermined speeds, surrounds the correct picture. Although the authors of First Words indicate that their program is designed for children with "cognitive ages from nine months to two years" of age, we have found this to be unrealistic. The reason for this is that the method of response can be too difficult for younger children.

Prior observations and testing show that many children understand the instructional goals of different software programs. However, the data collected on child performance shows them performing poorly because they get a lot of wrong answers trying to respond correctly. Hence, the data that is collected on the children's ability to identify pictures or letters, for example, can be misleading because the data may more accurately reflect the child's inability to respond appropriately.

The scanning mode in this and other programs has been used as an alternative to the keyboard. However, using scanning as the method of response requires certain skills by the child. The most important one, in my opinion, is one-to-one correspondence. Associating an arrow pointing to a letter, or a box surrounding a

picture, requires that a child have an understanding of one-to-one correspondence. The child must understand that at one moment the box is associated with one picture and the next moment associated with another. Further, the child must be able to wait until the arrow points to the correct answer, which requires a good attention span. In our experiences, children who understand the scanning concept are also the ones who understand the concept of one-to-one correspondence. In addition, although programs like First Words and A*B*C*Dragon can be adjusted for different scan speeds, children will still be required to wait for two, four, eight, or even ten seconds before they can respond correctly. This seems particularly difficult for the handicapped children who are highly impulsive.

In arcade type computer games, the form of response (eg. moving the joystick and pushing the 'fire' buttons) becomes almost second nature. What one is required to do to make things happen takes less and less thought. With young handicapped children, however, the process of learning <u>how</u> to respond to a program takes much longer. If young handicapped children are to use software programs independently then they must also be able to respond without having to 'think about it' each time.

Another problem related to response/input methods and software for young children has to do with the wide variety of software programs being developed. The problem is that programs are developed by various companies and often require different types of input or responses by a child. This requires that children be able to generalize and problem solve from program to program. Some software programs will expect input from the keyboard, some from the hand paddles. Even if children are using only the paddles, in some

programs they may be required to press the button and turn the knob, or turn the knob and then press the button, to just turn the knob, or to just press the button. This requires that children learn to generalize and this too seems particularly difficult for young handicapped children.

The problem of generalization also occurs because little, if any, type of curriculum sequence exists in the software currently available. This fact became apparent when several of the children completed a computer program on matching and identifying numbers from 1-10. The children were ready to move on to matching numbers from 11-20, but we could find no software programs which addressed this skill area. When we did find a program to meet this need, it required that the children learn a new form of response.

HARDWARE

An examination of hardware configurations cannot be considered separately from software programs. The interrelationship between software programming and hardware configurations is a very important one because one is dependent upon the other. The type of response mode being used will be dependent on the focus of the software program. Further, different response modes can be used only if a software program is written to use them.

Although the hardware configuration and/or response mode used by a young child could influence how well the child performs using a computer, little information exists on how different response modes might influence child performance. A research study conducted at HCCCP, and funded by the Office of Special Education (#G008302223) through the Department of Special Education, University of Kansas, was designed to determine if different types of response modes used

by young handicapped children would make a difference in the frequency and accuracy of responding to the same computer stimuli (Rettig, 1984).

In this study four different response/input methods were evaluated. These included: keyboard, keyboard adaption, paddles, and light pen. Twenty physically impaired and twenty mentally retarded children from 3-6 years of age participated in the study. A drill and practice color matching task was used as the response task in each response mode. Subjects were exposed to each response mode for six consecutive days.

Briefly, the results of the study indicated that different response modes do have an influence on a child's performance. Results indicated that the keyboard mode produced the highest frequency of responding but the lowest accuracy. The paddles response mode showed the most accuracy improvement over time. The keyboard adaption, paddles, and light pen response modes all were found to be more appropriate for young children than the keyboard mode. One reason for this is that the keyboard response mode was too distracting for the younger children. Many of these children would press keys on the keyboard with little or no regard for the learning task. One important aspect of the paddles response condition is that when using the paddles the children did not need to look away from the monitor screen. In the keyboard response condition children would have to look down to the keyboard and away from the screen in order to find the appropriate key.

In the everyday use of computers with young handicapped children in the schools we have found that almost any adaptation in response mode increases a child's accuracy. Colored stickers placed on

certain keys, keyboard overlays made of cardboard or plastic, joysticks and hand paddles, expanded keyboards, and different types of single switches can positively affect the child's ability to use the computer. One type of keyboard overlay which we have found to be good has been developed by Adaptive Technology, Brooklyn Center, MN. These overlays, made of hard plastic, fit over the keyboard and can be predrilled with holes over only the keys you want exposed. The cost is only $20 for each overlay.

One type of adaptive equipment which could be used by young children is the expanded keyboard. We have had an opportunity to use and examine several of these expanded keyboards including Keyport 717, Muppet Board, and the Unicorn Board. One advantage of these boards for young children is that pictures can be placed on them that a child would be required to press instead of the letters or numbers on the standard keyboard. The Muppet Board, for example, comes equipped with pictures. In addition, a larger space can be created for the child to press. On most of the expanded keyboards available, several 'keys' can be grouped together to form a large area over which a picture or symbol could be placed.

One program designed to take advantage of expanded keyboards, and with the needs of nonvocal children in mind, is Programs for the Early Acquisition of Language (PEAL) which was based on the work of Dr. Laura Meyers. The program uses the Muppet Board to foster language stimulation activities. The programs use different overlays for different instructional levels and can be used as a type of precommunication board for augmentative communication.

We have, though, found at least three disadvantages in using expanded keyboards with young handicapped children. First, some of

them expanded keyboards, such as Keyport 717, are big and bulky and take up a lot of space on a computer table. Because expanded keyboards like the Unicorn and Keyport are rather large, they require that children have good range of motion in order to be able to reach all parts of the keyboard.

The second problem is that the expanded keyboards also have 'keys' with spaces between them. We often see younger children pressing in the space between the keys on the expanded keyboards. When this happens there is, of course, no response. For young children with small hands and short arms, the range of motion required and the need to press a specific area limits the use of expanded keyboards.

Third, unless software is already available, teachers may be required to program the expanded keyboards themselves. This may be difficult for teachers with little computer or programming experience

As indicated earlier, joysticks and hand paddles offer another type of input method for young children. One advantage of this type of input is that a child is not required to look away from the screen. Most of the children enjoy using this method, even though they may not always use it properly. Sometimes children simply "play with" the joystick or paddles. We have also noticed that younger children are too rough with the standard joysticks and many of the joysticks don't last long.

One way we've increased the number of children who can access the computer, and still take advantage of the paddles type of input, is through the development of single switch input. Based in part on work done by staff at the Capper Foundation for physically impaired

children in Topeka, Kansas, we made up small, inexpensive adaptations we call Junction Boxes. The purpose of these 'boxes' is to let us use an adaptive single switch in any program which uses the game paddles as the principal means of input. The Junction Box attaches to the game paddle port on the Apple and allows us to plug in any type of single switch. Such switches have included grasp switches, large plexiglass switches, mercury switches, and tread switches. These are the same types of switches which can be used with the Adaptive Firmware Card and can be made easily by the teachers themselves.

The use of the Adaptive Firmware Card offers many children the opportunity to access software programs which they otherwise would not be able to use. The use of the Firmware Card with younger children is somewhat limited, however, without adaptations. To use the Adaptive Firmware Card a child would be required to have already mastered several skills. Among them are recognition and discrimination of letters and numbers and the ability to scan these characters, which requires a good attention span.

THE FUTURE

Increasing technological advances hold a great deal of promise for young handicapped children. Behrmann and Lahm (1983) suggest, for example, that computers can assist in environmental control and environmental manipulation for these children. It is important, however, that problems related to both software and hardware be addressed so that this technology can adequately meet the needs and abilities of these children.

Based on the research and practical experience of using computers with young handicapped children, I believe there is one type of

response mode which has great potential. This response mode is touch screens. Although not a response mode examined in the research study described above, there is reason to believe that touch screens would be the most appropriate means of response for young handicapped children. A combination of software and hardware, which provides a child with the opportunity to touch the screen to make the correct answer, would be a more functional and appropriate form of response for young children than others discussed.

Several problems have inhibited the use of touch screens. Among them are cost, availability, interfacing, and the limited number of software programs available to run on this equipment. However, Personal Touch in California, has developed a touch screen called Touch Window. Light in weight, and relatively inexpensive, Touch Window attaches to any monitor screen with velcro and plugs into the game paddle port of the Apple IIe. Although there are only a few programs which have been developed using the Touch Window, HCCCP is currently working on the development of software which uses the Touch Window as the primary form of response. Using this software, children would only need to press the screen to make their response.

Despite this and other advances, we must continue to identify what prerequisite skills are needed by young children for them to take full advantage of technological advances. Adaptive computer equipment must also be evaluated for the skills required to operate them. HCCCP has initiated efforts to develop what would become a computer access assessment instrument for young children. The purpose of this instrument would be to provide teachers with an easy way of determining a child's ability to access a computer system and

to provide a starting point for training in computer access.

In any discussion of computer access, the functioning level, and to a lesser extent, the age of the user, must be considered. Focusing on the functioning level of the child, rather than the age of the child is more relevant, because both the mental and physical age of the child are important determiners of computer access. Behrmann and Lahm (1983) have asked a related question: What minimal levels of functioning are required for a child to interact with computers? That is, how young or low functioning can a child be to use and take advantage of technology?

Determining what Behrmann and Lahm term the 'minimal levels of functioning required to use computers' is a critical issue if computers are to be used effectively in early childhood special education. One important aspect of determining what minimal levels of functioning are required is to determine what computer response modes are available and what computer access skills are needed.

Early childhood special educators are in the business of teaching prerequisite skills to young children. Pre-reading and pre-writing, for example, are frequently seen in the IEP goals for these children. Teaching computer access skills and teaching children the prerequisite skills to use adaptive computer equipment should be an important part of the early childhood curriculum. Prerequisite skills will differ, however, among children with different handicaps. For visually impaired children, learning the location of keys on the keyboard and learning to understand the speech synthesizer would represent important access skills. For physically impaired young children finding the most appropriate means of input, interfacing equipment, and teaching scanning would be important

beginning skills.

We have begun development on several software programs designed especially to help teach these children some of the prerequisite skills they need. For example, our Letter Find program was designed to teach visually impaired and blind young children the location of letters and numbers on the keyboard and to understand the speech synthesizer.

Another program, The Rabbit Scanner, was developed to help teach young physically impaired children how to scan. This program address several prerequisite skills such as scanning from left to right and waiting for the cursor to reach a specific location on the screen. The Rabbit Scanner program provides three simple activities to help teach children how to scan and can be adjusted to seven different speeds. In addition, activities are provided to let children practice shape and color discrimination. The program was developed to give young children some of the skills needed to operate electronic communication boards or to use the Adaptive Firmware Card.

SUMMARY

Determining the most effective and efficient means of response/input to computer systems is extremely important. It is essential that efforts to develop functional input methods continues.

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